MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: File

FROM: Kurt Swendsen

DATE: March 6, 2012

SUBJECT: State Revolving Fund Project No. 5441-01
City of Ann Arbor, Wastewater Treatment Plant
Green Project Reserve (GPR) Funding Cost Claculation

The purpose of this memo is to document the cost calculations for the green reserve funding for the SRF Project No. 5441-01. The approved project cost is $110,285,000. The portion of the project that qualifies as green is the entire blower control system replacement construction ($4,368,000). The total eligible construction cost is $92,929,000 and the approved project total for both segments is $110,305,000.

Therefore, the percertage of construction that is green is calculated as follows:

$$\frac{\text{Total Green Construction}}{\text{Total Construction}} \times 100 = \frac{\$\ 4{,}368{,}000}{\$92{,}929{,}000} \times 100 = 4.70\%$$

Total Green Costs = Project Cost x Percent = $110,305,000 x .0470 = $5,184,335

The principal forgiveness amount was determined using 50-percent of GPR associated costs.

$5,184,335 x 50% = $2,592,168

Therefore, the total principal forgiveness amount for the project is $2,592,168

Swendsen, Kurt (DEQ)

From: Jansma, Wendy (DEQ)
Sent: Monday, March 05, 2012 8:13 AM
To: Swendsen, Kurt (DEQ)
Subject: RE: Green

Kurt, because this is a financial segment, you need to prepare the OOA based on the entire project amount – don't try to split the costs between years. Take a look at one of the Detroit OOAs – 5175-03,04,05 were all pieces of the same project. Create the GPR amount based on the entire project costs.

From: Swendsen, Kurt (DEQ)
Sent: Monday, March 05, 2012 7:21 AM
To: Jansma, Wendy (DEQ)
Subject: RE: Green

I'll have to think this through. Applying the ratio to the construction line item confused me at first, but I see that you end up with a relatively similar number (the total green eligible amount was $4,400,000, and when I apply the ratio (which was 4.735%) to the construction line item I get an eligible amount of $4,400,200). Because Ann Arbor is segmented, I need to think this through. Here are some preliminary numbers so you can see why I'm thinking this project will need to apply the general rules slightly differently: The construction amount is $92,929,000, which is much greater than the first loan amount, which is $37,000,000. The green is only for this year's loan. If I apply the ratio to the 1st segment's OOA amount, I come up with $1,751,950. $875,975 is half of that, which is considerably lower than half of their actual green eligible construction, which is $2,200,000.
If I look at this as a financially segmented project, (and I've run an OOA DB spreadsheet for the entire loan), then I would get $110,285,000 x .04735 = $5,221,994.75. $5,221,994.75 x 0.5 = $2,610,997.375. That would be equivalent to $2,200,000 for 50% of the green eligible construction line item costs and $410,000 for the non-construction line items. I'd have to contact MFA with the new green amount (they think it is $2,200,000), but the city would be happy with it. What do you think of this second method, of using the entire project cost instead of the 1st segment OOA total cost?

Kurt

From: Jansma, Wendy (DEQ)
Sent: Friday, March 02, 2012 11:45 AM
To: Swendsen, Kurt (DEQ)
Subject: RE: Green

110,285 × .047 = $5,183,395 / 2 = $2,591,698

Kurt, there is plenty of GPR funds for SRF so I wouldn't worry about being off on the estimate versus the as-bid costs by the 32K. As far as the other GPR costs, whatever the construction ratio is of green/total, you apply that to the entire OOA amount to get the GPR share of the BA, FA, engineering, etc. Take a look our GPR on-line business cases (Plainfield Twp is a good example) of how the calculations go. Except, of course, this year it is 50%.

From: Swendsen, Kurt (DEQ)
Sent: Friday, March 02, 2012 11:30 AM
To: Jansma, Wendy (DEQ)
Subject: Green

4,368,000 / 4,400,000 / 92,929,000 = 4.7% = 4.735%

I am heading out soon, so I thought I'd write these questions to you instead of waiting to bring them up Monday:

1. What basis do I use to decide if construction engineering should be included with the

Swendsen, Kurt (DEQ)

From: Englert, Chris [Chris.Englert@arcadis-us.com]
Sent: Friday, March 02, 2012 10:29 AM
To: Swendsen, Kurt (DEQ)
Cc: Porter, Tom; Englert, Chris
Subject: RE: Green Documentation

Kurt,

I tracked down the blower cost information for the East and West blowers. The cost for the East blowers was estimate at $2,880,000 and the cost for the West blowers was estimated at $1,488,00 or a total of $4,368,000. That value was apparently rounded up to $4.4M. Let me know if you need any further clarification.

Thanks,
Chris

Christopher J. Englert, PE | Principal Environmental Engineer | Chris.Englert@arcadis-us.com
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ARCADIS, Imagine the result

From: Swendsen, Kurt (DEQ) [mailto:SWENDSENK@michigan.gov]
Sent: Friday, March 02, 2012 9:02 AM
To: Englert, Chris
Cc: Porter, Tom
Subject: Green Documentation

I can't find any written basis that explains why the green blower construction is $4,400,000. A July 18, 2011 email exchange between us says that the overall blower building cost is $5,880,000, and I ask for the cost of the blower equipment. I'm sure you must have been the person to tell me $4,400,000, but I don't see any evidence of it. Do you have such an email? If not, can you confirm that the non-building portion (the Blower equipment) of the Blower Building construction is $4,400,000?

The April 11, 2011 green business case document that you put together establishes the energy savings, but not costs, which is why I probably asked later for the costs.

Kurt Swendsen, DEQ
(517) 335-7429

Swendsen, Kurt (DEQ)

From: Englert, Chris [Chris.Englert@arcadis-us.com]
Sent: Friday, March 02, 2012 11:50 AM
To: Swendsen, Kurt (DEQ)
Cc: Porter, Tom; Englert, Chris
Subject: RE: Green Documentation

Kurt,

The $4.368M cost does not include any construction engineering costs, only the cost of the equipment.

Chris

Christopher J. Englert, PE | Principal Environmental Engineer | Chris.Englert@arcadis-us.com
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From: Swendsen, Kurt (DEQ) [mailto:SWENDSENK@michigan.gov]
Sent: Friday, March 02, 2012 11:32 AM
To: Englert, Chris
Cc: Porter, Tom
Subject: RE: Green Documentation

Sorry to bother you again, but I didn't have my questions fully thought through and have one more. Does the $4,368,000 figure include or exclude construction engineering costs attributed to MPI?

Kurt

From: Englert, Chris [mailto:Chris.Englert@arcadis-us.com]
Sent: Friday, March 02, 2012 10:29 AM
To: Swendsen, Kurt (DEQ)
Cc: Porter, Tom; Englert, Chris
Subject: RE: Green Documentation

Kurt,

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April 11, 2011

Mr. Kurt Swendsen, Project Manager
Revolving Loan Section
Environmental Response Management Division
525 West Allegan Street
P.O. Box 30473
Lansing, Michigan 48909-7973

Re: Green Business Case
Ann Arbor WWTP Aeration Blowers
SRF Project No. 5441-01

Dear Mr. Swendsen:

The attached Green Business Case for new aeration blowers at the Ann Arbor WWTP was prepared for your review. The document provides an estimate for the energy savings resulting from the new high efficiency Turblex blowers and blower control system included in the Facilities Renovation Project. The analysis estimates energy savings between 25 and 30% compared with the existing blower systems. A copy of this blower analysis was also provided to Ms. Tiffany Myers for her review.

Please call me at 313-965-8436 (ext. 20020) with any questions you may have.

Very truly yours,

MALCOLM PIRNIE OF MICHIGAN, INC.

Christopher J. Englert, P.E.
Senior Project Engineer

cc: Ms. Tiffany Myers, MDEQ
Mr. Earl Kenzie, Ann Arbor WWTP

Ann Arbor Blowers
Green Business Case & Power Savings Evaluation

The Ann Arbor WWTP green business case is based on energy savings associated with the installation of new Turblex blowers and blower control systems for the East and West Plants. This energy savings evaluation only considered blower and control system replacement. Therefore, the business case is a straight forward accounting of existing blower energy use compared with predicted new blower energy use. This cost evaluation is divided into several phases which identify the cost savings for 1) new Turblex blowers for East Plant, 2) new Turblex blowers for East & West Plants, and 3) energy savings for new dissolved oxygen feedback and most open valve (MOV) control systems.

The proposed replacement of the Ann Arbor WWTP blowers will result in a considerable electric power savings. The existing East Plant centrifugal blowers are oversized for current conditions ever since fine bubble diffusers were installed in the early 1990's. In addition, the existing control of the blowers is manual resulting in additional inefficiencies. The existing West Plant blowers are positive displacement-type blowers, which are less efficient than centrifugal blowers. The East and West Plant blowers will be replaced with new, higher efficiency Turblex blowers appropriately sized for each plant.

The increased efficiency of the new Turblex blowers is due to improved motor efficiency and adjustable guide vanes on the inlet and outlet to control air flow and discharge pressure. The blower output is automatically adjusted to match the actual air flow requirements based on continuous dissolved oxygen readings in the aeration tanks. Improved efficiency also results from providing appropriately sized blowers to match current and projected air demands. In general, WWTP installations where these blowers and control system have been installed have experienced savings in the area of 20 to 30% compared with existing aeration equipment and controls.

The attached table prepared by Turblex provides a comparison of the projected power consumption for the new East Plant blowers (Table 1) and for the existing East Plant blowers (Table 2) based on the air requirements during a typical year. For the new Turblex blowers, two units are needed to provide the air requirements, whereas, only one of the existing units (Roots OIB blower) would provide the air required. Additional information regarding the blower evaluation conducted by Turblex for the existing and proposed new blowers is also attached. The estimated energy consumption calculations for the existing Roots blower system totals 5,413,680 kWh/yr. The estimated power consumption using Turblex blowers is 4,212,684 kWh/yr. or a savings of 1,200,996 kWh/yr. The estimated electric power savings, between the existing blowers and new Turblex blowers, is 22% [(5,413,680 – 4,212,684)/5,413,680] x 100%.

It should be noted that this evaluation was only conducted using the operating performance characteristics for the East Plant blowers, since blower efficiency curves were readily available and all of the flow was directed through the East Plant during the period of evaluation (March 2009 through August 2010). As noted above, the West Plant blowers are positive displacement, which are less efficient than centrifugal blowers by

about 10%. If the flow were proportionately divided between the East and West Plants, the calculated power savings of the new blowers for the East and West Plants would be on the order of 25%.

This cost evaluation was conducted assuming the operator would manually adjust the existing blowers to match the required air flow. In actual operation, the Ann Arbor operators typically adjust the air flow two times per day (once in the morning and once at night) based on grab dissolved oxygen samples. In contrast, the new aeration system will have DO probes in three zones of each train, with control valves capable of adjusting the air flow to match the desired DO set point. In addition, the new system will have a "most open valve" control function which will minimize the header pressure (thus, power requirements).

According to real world experience shared by Turblex representatives, the added savings for these control features is in the range of 3% to 8% in addition to the 25% savings from comparison with the existing blower systems. Since the Ann Arbor WWTP spends approximately $510,000 per year on electric power for blowers, the city can expect to save approximately $128,000 (25% savings) to $153,000 (30% savings) per year using Turblex blowers and control systems.

Ann Arbor WWTP

STANDARDS

Standard Pressure (psi)	14.7 psi	psi
Standard Temperature (deg F)	68 deg F	deg F
Standard Relative Humidity	36%	

OPERATING CONDITIONS

Pressure (psia)	14.24 psia
Maximum Temperature (deg F)	100 deg F
Relative Humidity	60%
Average Temperatrure (deg F)	50 deg F
Relative Humidity	60%
Minumum Temperature (deg F)	0 deg F
Relative Humidity	20%

TOTAL AIR REQUIREMENTS

Maximum Air Requirements	18,300 SCFM
Maximium Discharge Pressure	7.9 psig

FLOW MODEL

	scfm	weight
High	18,300	10%
Average	16,870	75%
Low	15,700	15%

ENERGY COST

Current Average Energy Cost	0.08 $/kWh
Energy Cost Annual Increase	2.50%

TABLE 1 (ALTERNATIVE I - Turblex Single-Stage Blower)

ALTERNATIVE I	Air Requirements			Blower Air Flow		Operating Conditions		Blower Power Consumption				Power Totals		
	Point	Required Process Air Flow (scfm)	Discharge Pressure (psig)	Turblex Single Stage (scfm) (1)	Turblex Single Stage (scfm) (1)	Air Temp F	Humidity % RH	Turblex Single Stage Shaft Hp (1)	Turblex Single Stage Shaft Hp (1)	Motor Efficiency (2)	Total Blower Wire kW	Annual Hours of Operation	Energy Consumption kWh	Total Energy Cost $/year (4)
	High	18,300	7.90	9,150	9,150	100	60%	365	365	94.50%	576	876	504,576	$40,366
	Average	16,870	7.90	8,435	8,435	50	60%	304	304	94.50%	480	6,570	3,153,600	$252,288
	Low	15,700	7.90	7,850	7,850	0	20%	267	267	94.50%	422	1,314	554,508	$44,361

Total Annual Energy Consumption, Alternative I:	**4,212,684**	**$337,015**

TABLE 2 (ALTERNATIVE II - Existing Roots OIB Blower)

ALTERNATIVE II	Air Requirements			Blower Air Flow		Operating Conditions		Blower Power Consumption				Power Totals		
	Point	Required Process Air Flow (scfm)	Discharge Pressure (psig)	Existing Roots OIB scfm	Existing Roots OIB scfm	Air Temp F	Humidity % RH	Existing Roots OIB Shaft Hp (3)	Existing Roots OIB Shaft Hp (3)	Motor Efficiency (2)	Total Blower Wire kW	Annual Hours of Operation	Energy Consumption kWh	Total Energy Cost $/year (4)
	High	18,300	7.90	18,300	0	100	60%	848	0	90.00%	702	876	614,952	$49,196
	Average	16,870	7.90	16,870	0	50	60%	745	0	90.00%	617	6,570	4,053,690	$324,295
	Low	15,700	7.90	15,700	0	0	20%	684	0	90.00%	567	1,314	745,038	$59,603

Total Annual Energy Consumption, Alternative II:	**5,413,680**	**$433,094**